An Aptamer Modified Carbon Nanotube Field-Effect Transistor to Measure Insulin

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In 2018 around 250,000 individuals in New Zealand were diagnosed with diabetes[1]. Too high blood glucose levels associated with diabetes, can lead to consequences such as kidney failure or blindness. Diabetes is currently managed in a cumbersome and indirect way, whereby the blood glucose concentration is measured, and insulin is injected to compensate. If too little insulin is injected, the blood glucose level remains too high. Vice versa, injection of too much insulin can lead to a too low blood glucose concentration, with consequences like trembling, confusion, or even loss of consciousness. Regular point-of-care measurement of blood insulin, as opposed to glucose, would improve diabetes management by providing direct feedback of the amount of injected insulin.

In this paper we will describe the design of a portable, inexpensive and easy to use direct insulin sensor utilising a carbon nanotube (CNT) field-effect transistor (FET) system[2]. To achieve insulin selectivity the CNTs will further be modified with insulin-specific aptamers[3], DNA/RNA strands that change the conformation in the presence of a specific molecule. This change of conformation is utilised to bring negative charges of the aptamer chain closer to the carbon nanotube surface, resulting in a change in the transistor behaviour. As a result, the concentration of insulin can then be measured as a function of transistor current and voltage.

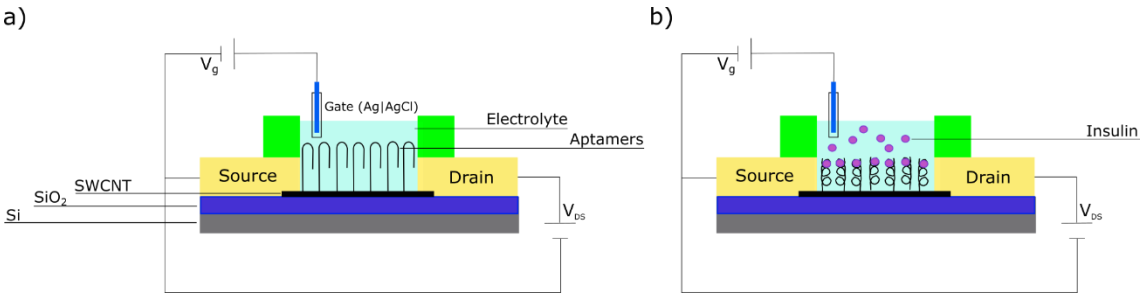

Figure 1: Schematic of the FET layout before (a) and after (b) reaction with insulin

References:

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